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Riparian influences on Phytoplankton Dynamics in Taylor Creek, Zarama, Bayelsa State

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Abstract Riparian influences on Phytoplankton Dynamics in Taylor Creek, Zarama, Bayelsa State was investigated. This was done in order gauge the effect of different human activities in the catchments on water quality. Four (4) sample stations were designated for the study having distinct land uses. Phytoplankton samples were collected and analysed using standard procedures. The distributions, abundance, species diversity, species composition of the phytoplankton were calculated for each of the study stations. Result show that a total of one hundred and five (105) species of phytoplankton belonging to nine (9) taxonomic groups were recorded from Taylor Creek in Zarama clan. Chlorophyta was represented by 43 species, Bacillariophyta (27 species), Cyanophyta (19 species), Pyrrophyta (6 species), Xanthophyta (1 species), Phaeophyta (4 species), Euglenophyta (2 species), Rhodophyta (2) and Chrysophyta (1 species).The dominance of the creek by Chlorophyta suggest high levels of nutrient enrichment, whereas the low presence of Euglenophyta and Rhodophyta confirms that the creek is unpolluted. Furthermore, the presence of diatoms (Bacillariophyta) confirms the unpolluted status of the creek. Diatoms are known to populate unpolluted waters. It can therefore be concluded that Taylor creek, Zarama is not under pollution threat.

Keywords Riparian, phytoplankton. Taylor creek, Zarama, pollution

1. Introduction

Aquatic organisms especially plankton forms the most sensitive components of the ecosystem and signal environmental disturbance. The knowledge of the abundance, composition and seasonal succession of the same is a prerequisite for the successful management of any aquatic ecosystem. Apart from primary production, phytoplankton plays an important role as food for herbivorous animals and act as biological indicator of water quality in pollution studies. The communities of phytoplankton are also used as an indicator of water pollution [1]. Phytoplankton study provides a relevant and convenient point of eutrophication and its adverse impact on an aquatic ecosystem [2]. Phytoplankton community structure in temperate rivers and lakes is usually influenced by factors such as light, nutrients and top-down control. However, hydrological mechanisms, as well as dilution and turbidity, are fundamental to the occurrence of phytoplankton populations in rivers [3, 4].

Despite the extensive Nigerian hydrographic system, the number of studies on phytoplankton community structure in lotic systems (13) is much smaller than in lentic ones (142) [5], and most are related to floodplain systems such as the Parana´ [6, 7] and Amazon rivers [8].

Due to the excess human activities in rivers in the Niger Delta region of Nigeria and use of the river as dump site in so many communities, the crude, the wastes streams discharge into the water bodies may include organic and inorganic waste such as heavy metals, chemical ions, oil and grease and other waste of organic origin [9, 10] which adversely affects the phytoplankton dynamics and therefore it is important to check the physical, chemical and biological variable of its rivers. Tayolor creek situated at Zarama axis is marked by a myriad of activities around the catchment. These activities influence the amount of waste inputs into it. There is a need therefore to monitor the phytoplankton dynamics of the creek in order to gauge the impact on the health of the river.

2. Materials and Methods

2.1 Study Area

The study area is Taylor creek in Zarama clan in Yenagoa Local Government Area, Bayelsa State. It is located in the southernmost part of Nigeria, with coordinates of latitudes 5^{o} 06$^{'}$ 41.0$^{''}$N and 5^{o} 05$^{'}$40.4$^{''}$N and longitudes 006^{o}24$^{'}$49.4$^{''}$E and 006^{o}23$^{'}$45.6$^{''}$E. The study area has a tropical humid hot climate with two prevailing seasons wet and dry.

2.2 Sampling Stations

Based on the peculiarities of the land sued adjacent to the creek, four sampling stations were identified and chosen for analysis. These are:

2.2.1 Station A (Nyambiri)

This station is located at latitude 05^{o} 06$^{'}$ 41.0$^{''}$N and longitude 006^{o} 24$^{'}$ 49.4$^{''}$E. it has a notable activity of washing, fishing and farming on the land adjacent to the creek.

2.2.2 Station B (Ishagbura)

This station is located at latitude 05^{o} 06$^{'}$ 22.1$^{''}$ N and longitude 006^{o} 24$^{'}$ 47.0$^{''}$E. Major activities going on around the creek are fishing and farming. Noticeable human settlements are also located around the station.

2.2.3 Station C (New Jerusalem)

This station is located at latitude 05^{o} 06$^{'}$ 41.0$^{''}$N and longitude 006^{o} 24$^{'}$ 49.4$^{''}$E. Notable activities of washing, fishing and farming. There is also local latrine located closed to the creek.

2.2.4 Station D (Market)

This station is located at latitude 05^{o} 06$^{'}$ 41.0$^{''}$N and longitude 006^{o} 24$^{'}$ 49.4$^{''}$E. It has a notable activity of washing, fishing and farming. There is market and dump sites located adjacent to the creek.

2.3.1 Sample Collection

Phytoplankton samples were collected in each sampling sites using labeled one litre wide mouthed plastic containers and immediately fixed with Lugol's solution, stored in a cool box and transported to the Department of Biological Science laboratory, Niger Delta University for identification and enumeration [11]. In the laboratory sample were allowed to stand for a minimum of 24 hours before the supernatant was carefully pipette off until a 50ml concentrated sample was achieved [12].

2.3.2 Counting and Analysis

In the laboratory, plankton samples were allowed to settle by gravity for 24 hours before decanting carefully the supernatant to achieve 50 ml volume. From the stock sample, 2 – 3 drops was taken with the help of a Pasteur pipette and transferred into a glass slide. A DC2 camera was attached to a computer. Maximize the screen and adjust the exposure and the camera is inserted into a light microscope (Lieder Model; MC 332). Identification guides of Botes [13] were employed for identification of phytoplankton to species level.

3. Result and Discussions

3.1 Result

Table 3.1 –Table 3.9 presents the total number of species belonging to each taxon, the mean and percentage occurrence of phytoplankton taxa in Figure 3.1 and ecological indices are presented in Table 3.10.

Table 3.1: Occurrence of Chlorophyta in sampling stations

S/N	Taxa/Species	Nyambiri Station 1	Ishagbura Station 2	New Jerusalem Station 3	Market Station 4
	CHLOROPHYTA				
1.	*Cladophora crispate*	-	1	1	1
2.	*Closterium lineatum*	-	3	-	-
3.	*Ankistrodesmus falcatus*	-	1	3	1
4.	*Pleurotaenium trabercula*	-	1	-	-
5.	*Coelastrum proboscideum*	-	1	-	-

6.	*Gonatozygon aculcatum*	-	2	-	-
7.	*Microspora sp*	2	1	-	-
8.	*Oedogonium sp*	2	1	1	3
9.	*Closterium sp*	-	2	-	-
10.	*Mougeotia sp*	4	1	3	3
11.	*Vaucheria sp*	-	1	1	1
12.	*Closteriopsis longissimi*	-	2	-	1
13.	*Closterium sp*	-	1	-	-
14.	*Geniculariaelegans*	-	1	-	-
15.	*Closterium aciculare*	1	1	-	-
16.	*Microspora sp*	-	-	-	1
17.	*Chactphora sp*	1	1	-	-
18.	*Quadrigulachodati*	-	-	-	1
19.	*Closterium gracile*	2	-	1	1
20.	*Closterium acerosum*	-	-	-	1
21.	*Pleurotaenium ovatum*	-	-	-	1
22.	*Cladophora sp*	-	-	3	5
23.	*Closterium macilentum*	-	-	-	-
24.	*Closterium junciduim*	-	-	-	2
25.	*Rhizodonium sp*	-	-	-	1
26.	*Cosmariummargaritiferum*	-	-	-	1
27.	*Pleurotanium baculoides*	-	-	-	1
28.	*Coleochate solute*	-	-	2	-
29.	*Volvox aureus*	1	1	-	-
30.	*Ulothrix sp*	1	1	-	-
31.	*Stigeoclonium sp*	1	-	-	-
32.	*Draparnaldia sp*	1	-	-	-
33.	*Spirogyra condensate*	-	1	-	-
34.	*Coelastrum reticulatum*	-	1	-	-
35.	*Spirogyra sp*	-	1	-	-
36.	*Coleochactescutata*	-	2	-	-
37.	*Protosiphon botryoides*	-	1	-	-
38.	*Closteriumcostatum*	-	1	-	-
39.	*Chlosteriumjunicidum*	-	1	-	-
40.	*Closteriumjenneri*	-	1	-	-
41.	*Desmidiumswartzi*	-	1	-	-
42.	*Nitellamucronata*	-	1	-	-
43.	*Gonatozygonpilosum*	-	1	-	-

Table 3.2: Occurrence of Bacillariophyta in sampling stations

S/N	Taxa/Species	Nyambiri	Ishagbura	New Jerusalem	Market
		Station 1	**Station 2**	**Station 3**	**Station 4**
	BACILLARIOPHYTA				
1.	*Synedra amphicepinala*	1	-	-	-
2.	*Tebellaria fenestrate*	1	1	-	-
3.	*Tebellaria flocculosa*	1	-	-	-
4.	*Asterionella Formosa*	1	-	-	1
5.	*Pseudo-nitzschia australis*	1	4	-	2
6.	*Melosira undulate*	1	1	-	-
7.	*Melosira sp*	1	-	-	1

8.	*Thalassionema nitzschindes*	1	2	-	1
9.	*Melosira granulate*	1	1	-	1
10.	*Nitzschia paradoxa*	1	-	-	1
11.	*Pseudo-nitzschia pungen*	-	1	1	2
12.	*Synedra sp*	-	1	1	-
13.	*Pseudo-nitzschia delicatissima*	-	1	1	-
14.	*Chara sp*	-	-	2	-
15.	*Guinardia sp*	-	-	1	
16.	*Achnanthes gracillina*	-	1	-	-
17.	*Pennales sp*	-	1	-	-
18.	*Navicula cryptocephala*	-	1	-	-
19.	*Skeletonema costatum*	-	1	-	-
20.	*Cymbella turnida*	-	1	-	-
21.	*Chara coralline*	-	1	-	-
22.	*Melosira 4 spaerica*	-	-	-	2
23.	*Cymbella amphioxus*	-	-	-	1
24.	*Fragillaria intermedia*	-	-	-	1
25.	*Synedra ulna*	-	-	-	1
26.	*Closterium striolatum*	-	-	-	1
27.	*Melosira italic*	-	-	-	1

Table 3.3: Occurrence of Cyanophyta in sampling stations

S/N	Taxa/Species	Nyambiri	Ishagbura	New Jerusalem	Market
		Station 1	Station 2	Station 3	Station 4
	CYANOPHYTA				
1.	*Aphanizomenom flos-aquae*	2	3	-	1
2.	*Calothrix*	-	1	-	-
3.	*Raphidiopsis curvata*	5	1	1	5
4.	*Dactylococcopsis irregularis*	2	2	2	2
5.	*Gloeotrichiaechinulata*	1	4	1	1
6.	*Protoperidiniumconicoides*	-	1	-	-
7.	*Nostoc planctenicum*	-	1	-	-
8.	*Gloeostrichia indica*	-	1	-	-
9.	*Dactylococcopsis acicularis*	-	3	-	-
10.	*Calothrix sp*	-	1	-	-
11.	*Oscillateria lacustris*	1	1	-	2
12.	*Anabaenopsis arnoldii*	-	1	-	-
13.	*Anabaenopsis raciborskii*	-	-	-	3
14.	*Spirulina subtilissima*	-	-	1	1
15.	*Spirulina major*	-	-	-	1
16.	*Oscillatoria amphibia*	-	-	1	-
17.	*Spirulina princepts*	-	-	1	-
18.	*Schizothrix sp*	-	-	1	-
19.	*Anabaena spiroides*	1	-	-	-

Table 3.4: Occurrence of Pyrrophyta in sampling stations

		Nyambiri	Ishagbura	New Jerusalem	Market
S/N	Taxa/Species	Station 1	Station 2	Station 3	Station 4
	PYRROPHYTA				
1.	*Peridiniumcinctum*	-	-	-	1

2.	*Gymnodiniumfuscum*	-	-	-	1
3.	*Gymnodiniumaeruginosum*	-	1	-	-
4.	*Peridiniumlatum*	1	-	-	-
5.	*Peridiniumwellie huitf*	1	-	-	-
6.	*Cryptomonassp*	1	-	-	-

Table 3.5: Occurrence of Xanthophyta in sampling stations

S/N	Taxa/Species	Nyambiri Station 1	Ishagbura Station 2	New Jerusalem Station 3	Market Station 4
	XANTHOPYTA				
1.	*Ophiocytium cochleare*	1	-	-	-

Table 3.6: Occurrence of Phaeophyta in sampling stations

S/N	Taxa/ Species	Nyambiri Station 1	Ishagbura Station 2	New Jerusalem Station 3	Market Station 4
	PHAEOPHYTA				
1.	*Focus gardneri*	-	2	-	-
2.	*Focus ova*	-	3	-	-
3.	*Macrocystis pyrifera*	-	2	-	-
4.	*Dictyotabartray resiana*	-	1	-	-

Table 3.7: Occurrence of Euglenophyta in sampling stations

S/N	Taxa/Species	Nyambiri Station 1	Ishagbura Station 2	New Jerusalem Station 3	Market Station 4
	EUGLENOPHYTA				
1.	*Trachelomonas similis*	-	1	-	-
2.	*Trachelomonas hispida*	-	2	-	-

Table 3.8: Occurrence of Rhodophyta in sampling stations

S/N	Taxa/Species	Nyambiri Station 1	Ishagbura Station 1	New Jerusalem Station 1	Market Station 1
	RHODOPHYTA				
1.	*Polysiphoriapla tycarpa*	-	1	-	-
2.	*Polysiphonia violacea*	-	1	-	-

Table 3.9: Occurrence of Chrysophyta in sampling stations

S/N	Taxa/Species	Nyambiri Station 1	Ishagbura Station 2	New Jerusalem Station 3	Market Station 4
	CHRYSOPHYTA				
1.	*Stephanodiscus sp*	-	1	-	-

Table 3.10 Showing Ecological Indices

Taxa/Species	Station 1	Station 2	Station 3	Station 4
Chlorophyta (has the highest specie richness across stations)	*11(35)*	*28 (43.7)*	*10 (45.4)*	*18 (43.9)*
Bacillariophyta	*10 (32)*	*14 (21.8)*	*5 (22.7)*	*13 (31.7)*
Cyanophyta	*6 (19)*	*12 (18.7)*	*7 (31.8)*	*8 (19.5)*
Pyrrophyta	*3 (9.6)*	*1 (1.5)*	*-(0)*	*2 (4.8)*
Xanthophyta	*1(0.3)*	*- (0)*	*- (0)*	*- (0)*

Phaeophyta	*- (0)*	*4 (6.2)*	*- (0)*	*- (0)*
Euglenophyta	*- (0)*	*2 (3.1)*	*- (0)*	*- (0)*
Rhodophyta	*-(0)*	*2 (3.1)*	*- (0)*	*- (0)*
Chrysophyta	*-(0)*	*1 (1.5)*	*- (0)*	*- (0)*
Total no of species in station	*31(100)*	*64(100)*	*22(100)*	*41(100)*
Shannon diversity index	1.27	1.51	1.04	1.17
Evenness	0.04	0.02	0.04	0.02
Simpson dominance index(s)	0.27	0.23	0.32	0.32

Percentage values are in Italic

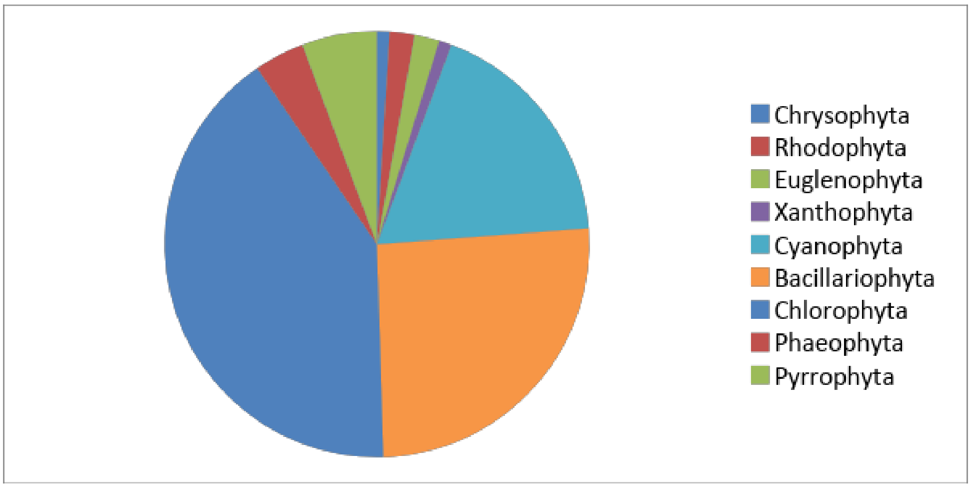

Figure 3.1: Percentage occurrence of phytoplankton taxa in the study area.

3.2 Discussion

A total of one hundred and five (105) species of phytoplankton belonging to nine (9) taxonomic groups were recorded from Zarama clan in Taylor Creek. Chlorophyta was represented by *40.9%, Bacillariophyta 25.7%, Cyanophyta 18.09%, Pyrrophyta 5.7%, Xanthophyta 0.9%, Phaeophyta 3.8%, Euglenophyta 1,9%, Rhodophyta 1.9% and Chrysophyta 0.9%.* Total number of species belonging to each taxon is presented in Table 3.1 –Table 3.9. The mean and percentage occurrence of phytoplankton taxa in Figure 3.1 and ecological indices are presented in Table 3.10.

The high and low number values of phytoplankton in this study are due to contributions from nutrient, disturbance by human, dump sites proximity, anthropogenic activities. Some activities such as sewage from the market, human activities such as washing, domestic activities etc also contribute to inputs into the creek. This finding is in agreement with ([14, 15]. While the findings were slightly different from the work of [16, 17, 18, 19].

The high prevalence of cyanophyta suggests that blue-green algae are not harmed by high temperature and intense illumination and therefore may have been abundant due to this adaptation. Another reason may be due to the low concentration of nitrogen and phosphorous in the study stations. The ability of cyanophytes to fix nitrogen may give them a competitive advantage in their prevalence when nitrogen is low. The prevalence of diatoms (Bacillariophyta, Chrysophyta) in this study suggests unpolluted waters. Diatoms have been known to dominate unpolluted lotic waters bodies in the tropics. In contrast, the occurrence of the euglenoids in sparse amounts only in one station of the study shows that the creek may have been exposed to mild levels of pollutants in the past.

The species evenness in all sampling stations in the study was low. This may be due in part to human actions which often drive contemporary biodiversity declines. In particular, land use changes, nutrient enrichment, exotic species invasion and climate change are often considered some of the ubiquitous factors driving such *change [20]. Low species evenness and richness in an ecosystem is often an indication of low productivity and poor ecosystem health.*

Also, the uniform low species evenness in all stations can be explained by the fact that the creek is a lotic water body. This implies that changes in both physicochemistry and bio-indices are greatly reflected and duplicated along gradient lines. This is contrary to lentic waters that are relatively still and riparian influences are more markedly divergent along gradient lines.

4. Conclusions

Due to their high occurrence and rapid response to environmental conditions, phytoplankton's are of great importance in bio-monitoring of pollution. The distributions, abundance, species diversity, species composition of the phytoplankton are used to assess the biological integrity of water bodies. From the above, there may be altered physico-chemical properties of water as a result of increased nutrients content such as phosphate and sulphate. Nitrates are known to encourage algal blooms. Human activities and other anthropogenic activities may alter the growth of Phytoplankton. The high presence of the green algae (chlrophyta) seem to suggest nutrient enrichment in the creek, while the presence of cyanophyta seem to indicate the contrary, suggesting that nutrient levels are in a state of constant flux. The presence of diatoms in high amounts also suggests an unpolluted ecosystem. Finally, the relative absence of euglenoids, indicate a relatively unpolluted environment. It can therefore be concluded that Taylor creek, Zarama is not under pollution threat. Phytoplanktons are of great importance in bio-monitoring of pollution and biological integrity of the water bodies. Therefore, phytoplankton study should be encouraged in the monitoring of pollution

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